II.—*On the Osteology, Pterylosis, and Muscular Anatomy of the American Fin-foot* (Heliornis surinamensis). By Frank E. Beddard, M.A., F.R.S., Prosector to the Zoological Society of London, Examiner in Biology to the Royal College of Surgeons.

The Heliornithidæ, comprising the two genera *Heliornis* and *Podica*, have been investigated anatomically by Brandt*, Nitzsch†, Giebel‡, Gadow§, and myself||. The affinities of these birds have been furthermore discussed by Fürbringer¶. The American Fin-foot, *Heliornis*, is at present less well known than the African form. Nitzsch has described its pterylosis, Giebel gave a few brief notes upon the muscular anatomy, while Gadow has investigated the intestinal coils. Having had the opportunity two years ago of examining and reporting upon the structure of the African Fin-foot, I am particularly glad to be able now to supplement that paper by some account of the American Fin-foot. The material upon which the present paper is based I owe immediately to the kindness of Mr. Sclater, and more indirectly to that of Mr. J. J. Quelch, the Superintendent of the Museum, George Town, British Guiana, who, at Mr. Sclater's request, obtained the specimens. The object of this paper is to compare the structure of the two genera *Heliornis* and *Podica* in those points as to which I was not able to make a comparison in my paper upon the anatomy of the latter. The comparisons now made

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* "Einige Bemerkungen über *Podoa* und ihr Verhältniss zur *Fulica*, *Podiceps*, und den Steganopoden," forming section iii. of "Beiträge zur Naturgeschichte der Vögel" &c., Mém. Ac. St. Pétersbourg, sér. 6, t. iii. (1840).

† 'Pterylography.' Engl. transl. by P. L. Sclater. Ray Society. 1867.

‡ "Zur Naturgeschichte des Surinamischen Wasserhuhn's (*Podoa surinamensis*)," Zeitschr. ges. Naturw. Bd. xviii. (1861) p. 424.

§ "On the Taxonomic Value of the Intestinal Convolutions in Birds," P. Z. S. 1889, p. 303.

|| "On the Anatomy of *Podica senegalensis*," P. Z. S. 1890, p. 425.

¶ 'Untersuchungen zur Morphologie und Systematik der Vögel, p. 1029 *et seqq.*

chiefly concern the muscular anatomy. I have not attempted any further discussion upon the affinities of the Heliornithidæ to other families of birds. The facts which I have been able to make out with regard to *Heliornis* do not render necessary any modification of the opinions which I expressed in my paper upon *Podica senegalensis.* Such differences as exist in the anatomy of the two genera appear to me to be correlated with the smaller size of *Heliornis.* In many groups of the animal kingdom we find that the smaller members show a simplification of structure as compared with the larger forms.

I. *Pterylosis.*

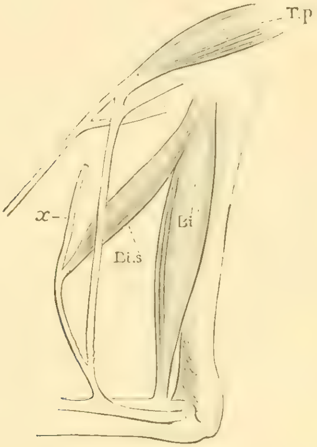
The pterylosis of this bird has been already described by Nitzsch (*op. cit.* p. 127, pl. viii. fig. 9). When the bird is plucked the feather-tracts are rendered rather inconspicuous by the presence of down feathers, which are scattered more or less uniformly all over the back, and which occur on the ventral surface of the body, particularly along the line of the sternal keel. I find that, as Nitzsch has stated, the neck is nearly continuously feathered, there being no lateral, and only a short ventral, bare tract. The dorsal tract is strong between the shoulder-blades and is distinctly forked; each branch of the fork is only two or three feathers wide; the hinder portion of the tracts is weak, but the feathering becomes strong soon after they have joined posteriorly; the junction of the two tracts occurs at the anterior end of the pelvis.

Nitzsch says nothing of the ventral tracts in his special description of *Heliornis,* but distinguishes the genera *Fulica, Heliornis,* and others by the undivided ventral tracts. This was certainly the arrangement in the specimens which I examined. The median ventral apterion extends about an inch up the neck.

II. *Muscular Anatomy.*

The *patagial muscle* is, as in *Podica senegalensis,* single; just before the origin of the two tendons into which it divides it receives a strong tendinous slip from the deltoid ridge of the humerus. There is another slip reinforcing the *longus* tendon. The tensor patagii brevis tendon is perfectly similar to that of the African Fin-foot; the biceps slip, however, instead of ending freely upon the patagium, as it does in that bird, joins the tendon of the tensor patagii brevis, which is also an unusual arrangement, it being, of course, more commonly attached to the tendon of the tensor patagii longus. The actual dispositions and connections of the several muscles and tendons, which are somewhat complicated, are shown in the accompanying drawing (fig. 1). The biceps slip passes, of course, below the tendon of the tensor patagii brevis; on the distal side of this tendon it ends in a tendon which runs down the patagium and is inserted on to the tensor patagii tendon just before its insertion. The tendon of the biceps slip is exceedingly fine, and not always, for this reason, visible; in one specimen it appeared to be inserted independently on to the fascia covering the muscles of the forearm; in another specimen the tendon of the biceps slip was bifurcate just at its end. Where the other tendon lettered *x* in the

Fig. 1.



Patagial muscles of *Heliornis surinamensis.*—*T.p.*, tensor patagii; *Bi.*, biceps; *Bi.s.*, biceps slip; *x*, tendinous slip inserted on patagium (?).

drawing ended I am unable to say. Evidently, therefore, there are differences in respect of this muscle between the American and African Fin-foots.

In many birds, for instance in the Duck (see Fürbringer, *loc. cit.* Taf. xx. fig. 4), the biceps slip joins the tendon of the tensor patagii longus just at the insertion of the fan-shaped tendon which very commonly unites that tendon with the tendon of the patagii brevis at its insertion. I am inclined to think that the long and delicate tendon connected with the biceps slip of *Heliornis* is the equivalent of that tendon which has lost its attachment to the tendon of the tensor patagii longus; if so, then the tendons of the patagium of *Heliornis* are less abnormal than one would otherwise regard them.

Latissimus dorsi.—This muscle is composed of the usual two parts: the anterior portion is, also as usual, the weaker of the two; it arises from the spines of the dorsal vertebræ; the origin of the posterior half of the muscle follows immediately upon it; the posterior half of the latissimus dorsi arises also from the front border of the ilium. The anterior half of the muscle has a broad tendinous insertion, which commences just behind the short, flat, and narrow glistening tendon by which the posterior half of the muscle is attached to the humerus.

Anconæus longus.—This muscle appears to arise and to be inserted precisely as in *Podica senegalensis.* The accessory tendon, which is about one half the width of the tendon of insertion of the posterior half of the latissimus dorsi, is inserted on to the humerus above the latter.

Expansor secundariorum.—In the fact of the presence of this muscle the American Fin-foot agrees with the African form. The tendon is very thin, though strong; it increases somewhat in thickness as it approaches the teres.

Pectoralis primus.—I could not detect any division of this muscle into two layers, such as occurs in many birds, including *Podica senegalensis.*

The *pectoralis secundus* extends back in its origin nearly to the end of the sternum.

The *deltoid* is well developed; it is inserted on to rather more than the first half of the humerus.

The *biceps* arises by the usual long tendon from the scapula.

Both the *rhomboidei* have, as in *Podica senegalensis,* an aponeurotic origin from the vertebral column. The superficial rhomboideus is quite double the length of the deeper muscle, and overlaps it for nearly its whole length.

The *tensor fasciæ* is large; the anterior half of the muscle has a tendinous origin, the posterior half a muscular origin, which extends a long way behind the acetabulum.

The *biceps* is at its origin completely covered by the last muscle; indeed, the origin of the tensor fasciæ extends considerably beyond the point where the origin of the biceps leaves off; this muscle is comparatively slight, only 8 mm. in diameter at its origin, which is fleshy. The biceps has two insertions: one of these is like that found in nearly all other birds, *i. e.* it ends in a stout tendon, which passes through a tendinous loop, and is inserted on to the tibia; the second insertion is on to the fascia covering the gastrocnemius.

In describing the anatomy of *Podica senegalensis* I had occasion to point out* the very remarkable conformation of the biceps femoris in that bird, which has three separate insertions, and is more complicated than in any other bird of which the muscular structure is known. It will be observed that the biceps femoris of the American genus is like that of the African, with the only exception that it wants the third insertion present in the former. The condition of this muscle in the two genera of Heliornithidæ seems to show that the smaller American form has a more simplified structure when compared with its larger African relative. I point out later that the skull-characters show the same kind of reduction, which I cannot help associating with the size of the bird.

The *semitendinosus* and the *semimembranosus* may be considered together, for they form one continuous mass at their origin, of which the two constituent parts were indistinguishable in the individuals which I dissected; the origin of these two muscles commences exactly at that point where the origin of the tensor fasciæ leaves off. The insertion of the semimembranosus is flat and tendinous; it lies above the insertion of the semitendinosus, which is also flat and tendinous; the tendinous insertion of the semitendinosus is 9 mm. across; it nearly completely overlaps the 6 mm. wide insertion of the semimembranosus, when the thigh is examined from the inside.

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* *Op. cit.* p. 429.

In *Podica senegalensis* these two muscles are inserted one above the other, the insertions not overlapping at all, indeed not quite meeting.

As is the case with *Podica senegalensis, Heliornis surinamensis* has no *accessory semitendinosus.* It has, however, like the former bird, both the *femoro-caudal* and *accessory femoro-caudal.*

There are two *adductors* and, of course, an *ambiens.*

The *gastrocnemius* has a large outer and inner head; there is a very slender middle head; its tendon is ossified.

The *tibialis anticus* is partly covered over, as is frequently the case, by the *peronæus brevis.* It has a single insertion, and its tendon is ossified up to within 1 mm. of the ankle-joint. Both peroneal muscles are present.

The *peronæus brevis,* as has already been mentioned, partly covers over the tibialis anticus; its tendon of insertion is at first ossified; it is rather broad, and seems partly, at least, to join the tendon of the gastrocnemius at the insertion.

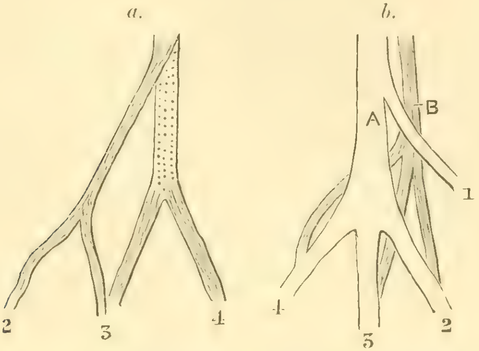
The *peronæus longus* is also covered by the *peroneus brevis*; it runs alongside of the *tibialis anticus*; its tendon is also ossified and is inserted in the usual way.

The tendon of the *extensor communis digitorum* (fig. 2, *a*, p. 36) has two separate ossifications, one just at its commencement, the other along the metatarsus; at the commencement of the second ossified tract a branch is given off, which supplies the second and third toes; at the end of the ossified tract the tendon divides into two for the third and fourth toes.

The superficial flexor tendons, which are, as usual, seven in number, are ossified.

The arrangement of the deep flexor tendons is illustrated in the accompanying drawing (fig. 2, *b*). It will be observed that each tendon splits into three, apart from the special branch to digit 1 given off from the flexor hallucis.

Fig. 2.



Heliornis surinamensis.—*a.* Tendon of extensor communis digitorum supplying second, third, and fourth digits (2, 3, 4). *b.* Deep flexor tendons: A. Flexor hallucis; B. Flexor communis. The slips going to the digits are numbered in accordance 1, 2, 3, 4. The ossified region of the tendon is indicated by dots.

III. *Visceral Anatomy.*

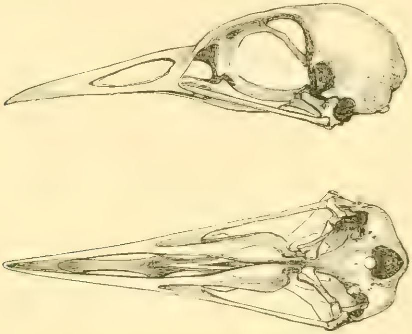
I do not think that it is necessary to give a detailed account of the alimentary tract of this bird. In the first place, the viscera were not in a very good condition for furnishing a careful report; they were softened by the action of the weak spirit in which they had been preserved, and were at the same time much adherent. In the second place, the main characteristics of the viscera are precisely as in *Podica*; in both genera the right liver-lobe is larger than the left, and there are a pair of moderately long cæca present.

In the syrinx the bronchidesmus is incomplete, there being a gap of about 2 mm. in length between the diverging bronchi. There are ten to twelve bronchial semirings on each side. The last three or four tracheal rings are partly fused (incompletely in front) to form a box. The single pair of intrinsic muscles is present.

IV. *Skull.*

The skull of *Heliornis* (fig. 3) differs but slightly, as I have already pointed out, from that of *Podica*. It is smaller, and the remaining differences may perhaps be accounted for by this: that is to say, the processes and fossæ from which muscles arise, or to which they are attached, are less strongly marked in the more slightly built *Heliornis*.

Fig. 3.

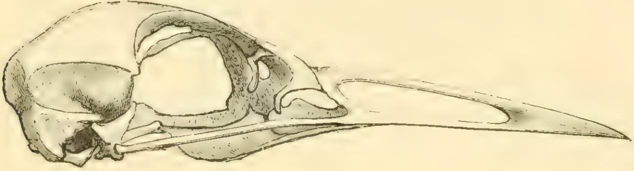


Skull of *Heliornis surinamensis*, nat. size.

Particularly is this the case with the temporal fossæ. In *Podica* (*cf.* fig. 4, p. 38) these fossæ, although not nearly so marked as in the Grebes, are fairly deep and extend back to the posterior face of the skull. In *Heliornis*, on the contrary (see fig. 3), the fossæ are slight; they only extend over half the lateral surface of the brain-case; furthermore, the two processes of the skull-wall (postfrontal and zygomatic) which limit, above and below, the commencement of the temporal fossæ are directly above and below each other respectively in *Heliornis*; in *Podica* the lower process, which corresponds to the zygomatic process of the squamosal in mammals, does not jut out so far forward as to lie beneath the superior process.

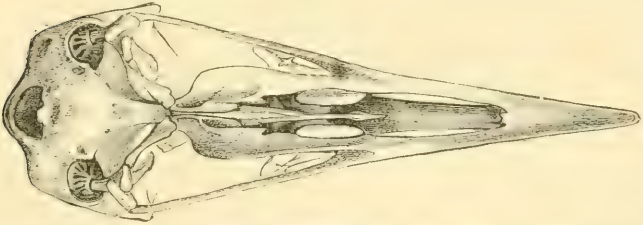
In my paper upon *Podica senegalensis* I drew attention to a point of difference between the Rails and the Grebes in the large size of the maxillo-palatines of the former. In such a Rail as *Ocydromus australis* the maxillo-palatines are comparatively large inflated bones, which, although covered, are not concealed by the narrow anterior part of the palatines which underlie them; in *Podiceps cornutus* the maxillo-palatines are much slighter and only just appear on the inner side of the palatines. *Podica senegalenis* (figs. 4 and 5) is more Rail-like than Grebe-like in this structural feature. On the other hand, the American Fin-foot is rather more Grebe-like than Rail-like. The maxillo-palatines are thin curved plates of bone, which are even less exposed than in *Podiceps cornutus* when the skull is viewed from below; this is owing to the fact that they are more curved, with the hollow surface directed outwards; in the Grebe these plates are nearly parallel with the long axis of the skull, the concave surface being directed downwards: in reality, therefore, the resemblance of the maxillo-palatines of *Heliornis* to those of the Rail is closer than to those of the Grebe; the outer plate of bone which would convert the thin scroll-like maxillo-palatines of *Heliornis* into the inflated maxillo-palatines of *Ocydromus* or of *Podica* is wanting. In the Grebe the form and direction of the maxillo-palatines are such that an additional

Fig. 4.



Skull of *Podica senegalensis*, lateral view; nat. size. (From P. Z. S. 1890, p. 433.)

Fig. 5.



Skull of *Podica senegalensis*, ventral view; nat. size. (From P. Z. S. 1890, p. 434.)

plate of bone could not convert them into the similitude of the inflated bullæ of the Rails.

Other smaller points of difference will be apparent from a comparison of the accompanying figures of the skulls of *Heliornis* and of *Podica**.

V. *Sternum.*

The sternum, as will be seen by the figures (6 and 7), does

Fig. 6.

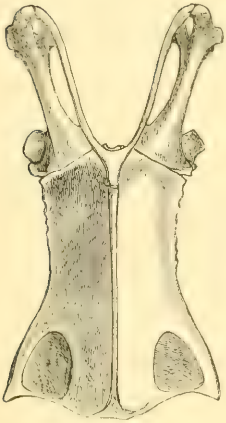


Fig. 7.

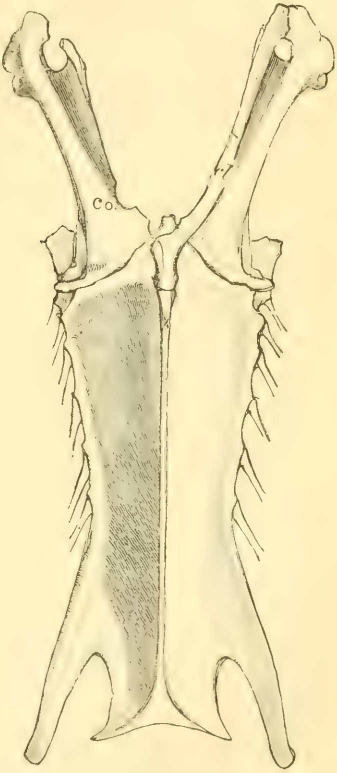


Fig. 6.—*Heliornis surinamensis.* Sternum, ventral view; nat. size.

Fig. 7.—Sternum of *Podica senegalensis,* ventral view; nat. size. *Co.,* coracoid; *cl.,* clavicle (removed on right side). (From P. Z. S. 1890, p. 435.)

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* For the use of the figures of *Podica* I am indebted to the kindness of the Publication Committee of the Zoological Society.

not widely differ from that of *Podica*; the lateral margins are more concave, since the lateral processes jut out at a larger angle with the median axis. These processes, moreover, do not extend beyond the posterior margin of the sternum. The sternum also is shorter in proportion to its length in the American than in the African Fin-foot.

The measurements of the sternum of *Heliornis* are as follows:—Length 35 mm.; least breadth 16 mm.

With these measurements may be compared those of *Podica*:—Length 68 mm.; least breadth 20 mm.

The median interclavicular piece of the merrythought is not prolonged forwards, as it is in *Podica*.

VI. *Pelvis.*

There are hardly any points of difference between the pelvis of *Heliornis* and *Podica*. All the characteristic features of this part of the skeleton as described in *Podica* exist in *Heliornis*. The ridges on the ischia are, however, less conspicuous in the American Fin-foot.

I have already compared the *ribs* and *vertebræ* of these two birds, and need not recapitulate here what has been said in my paper in the P. Z. S. (*t. c.*).

III.—*On the Extinct Giant Birds of Argentina.*

By R. Lydekker.

For the last few years the palæontological world has been flooded with accounts of the wonderful discoveries of mammalian remains belonging to new or little known types which have been made in the Tertiary deposits of Argentina. These discoveries have rendered it certain that, instead of having to do merely with a single fauna of Pleistocene age, we have there laid before us a whole series of faunas, which evidently occupied a considerable portion of the Tertiary period. The geologists and palæontologists of Argentina are, indeed, of opinion that the deposits yielding vertebrate remains are equivalent to the whole of the European Tertiary series, from